

Washington's Marine Biotoxin Monitoring Program

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Marine biotoxins found in Washington's waters, caused by harmful algal blooms (HABs).

There are principally two marine biotoxins of concern to public health in the marine waters of Washington. The first one, which has been around for many decades, causes Paralytic Shellfish Poisoning (PSP). It is caused by a dinoflagellate—*Alexandrium catenella*—which produces an entire family of toxins. People become ill when they consume shellfish, which have concentrated the toxins. The best-known toxin is called saxitoxin, which was first isolated from the Washington Butter Clam (*Saxidomus giganteus*). Symptoms are neurological and include tingling of the lips and tongue, numbness of arms, legs and neck, general muscular incoordination, dizziness, weakness, drowsiness and incoherence, headache, rapid pulse and respiratory distress, vomiting, diarrhea and abdominal pain, muscular paralysis and death (in as little as 15 minutes).

The second marine biotoxin, domoic acid, causes Amnesic Shellfish Poisoning (ASP) also called Domoic Acid Poisoning (DAP). ASP is caused by a number of diatoms in the genus *Pseudonitzschia*. Four species, *pungens*, *multiseries*, *australis*, *pseudodelicatissima* have been identified in Washington waters. *Pseudonitzschia seriata* has been identified in Alaska as a toxin producer, however, it has not been identified as a problem species in Washington waters. Symptoms are grouped in two categories: gastrointestinal and neurological. Symptoms caused by exposure to low levels of toxicity, which become apparent within the first 24 hours after consumption, are gastrointestinal. They include vomiting, abdominal cramps, diarrhea and nausea. Exposure to high levels of toxicity produces the following neurological symptoms after 48 hours: headache, dizziness, confusion, disorientation, short-term memory loss, motor weakness, seizures, coma and death.

Department of Health (DOH) role in biotoxin monitoring

Biotoxin Program Goal

To protect the health of shellfish consumers by monitoring for, and responding to biotoxins.

► Monitoring Program

Shellfish Collection and Testing

Sentinel Mussel Cages

In 1978, the Shellfish Program began Wild Mussel sample collection from a number of South Puget Sound locations. In 1989, this program was expanded to use mussels as an early-warning system for PSP. Mussels were suspended in cages from over 70 locations around Puget Sound, Grays Harbor and Willapa Harbor. The Office of Food Safety & Shellfish Programs staff restocks the cages. Commercial companies, local health department staff and citizen volunteers collect and transport the samples to the Public Health Laboratory.

Industry

Approximately 50 commercial shellfish growers representing all major shellfish growing areas submit samples for PSP and or domoic acid testing. Historically, commercial samples were collected from April through October. Since 1990, commercial monitoring has been conducted year around. This includes a Pink and Spiny Scallop commercial industry with a season from November through June.

Local Health Jurisdictions and Volunteers

Local health department staff and citizen volunteers collect shellfish from public beaches and transport the samples to the Public Health Laboratory.

Other State Agencies

Staff from the Departments of Natural Resources, Fish and Wildlife and Agriculture collects molluscan shellfish and crab samples for testing for PSP and Domoic Acid.

Tribes

Nineteen Washington Indian Tribes participate in the Marine Biotoxin Monitoring Program. Molluscan shellfish and Dungeness crab samples are collected for PSP and Domoic Acid testing. Samples are submitted prior to a tribal harvest for both commercial and Ceremonial and Subsistence (C&S) harvesting. Sampling continues throughout the period of harvest.

► Action Levels

Close

Shellfish harvest areas are closed when PSP or domoic acid are detected in shellfish at the following levels:

- PSP – When the toxin level equals or exceeds 80 µg/100g shellfish tissue
- Domoic Acid - When the toxin level equals or exceeds 20 ppm in shellfish tissue
- Domoic acid - Dungeness Crab - When the toxin level equals or exceeds 30ppm in crab viscera.

Reopen

Shellfish harvest areas can be reopened when two shellfish samples, collected 7 to 10 days apart meet the following criteria:

- PSP: Less than 80 µg/ 100g tissue.
- Domoic Acid: Less than 20 ppm.

Whereas a single sample of shellfish can close a shellfish harvest area, the reopening of the area may require samples of many different shellfish species. This is because different species of shellfish pick up and retain toxins at different rates. Blue mussels are quick to pick up PSP toxin and also quick to purge the toxin, once the mussels stop feeding on the toxic algae. At the other extreme are shellfish such as Butter Clams, that are slow to pick up PSP toxin and are also slow to purge the toxin.

► HAB History (Early)

1930

PSP testing in Washington began in the 1930s when many PSP illnesses and deaths occurred in California.

1942

Three human deaths occurred after consumption of clams and mussels from the Strait of Juan de Fuca near Port Angeles. Tests indicated the shellfish contained 3,500 µg of PSP toxin. Subsequent testing indicated that PSP was only a risk on the ocean beaches and the western part of the Strait of Juan de Fuca between the spring and fall months. The Department of Fisheries issued a regulation that annually closed the Strait west of Dungeness Spit and the ocean beaches from April through October.

1957

A severe outbreak of PSP in nearby British Columbia in 1957 prompted Washington to expand its monitoring program to include the northern inland waters of the state.

1978

In 1978 widespread toxicity, as high as 30,000 µg in mussels, occurred in the Whidbey Island area, causing 10 serious illnesses. Monitoring was expanded to include most of Puget Sound.

1988

In 1988 PSP was detected in oysters as high as 2,200 µg from Carr Inlet, causing the first closure south of the Tacoma Narrows Bridge. Monitoring is now conducted uniformly throughout all waters regardless of history of PSP.

1991

In September 1991, the death of marine birds (Cormorants and Pelicans) in California raised suspicions that domoic acid could be present off Washington's coast. In October 1991, domoic acid was detected in coastal Razor clams and Dungeness crab viscera. A monitoring program was established for molluscan shellfish and Dungeness crab. Currently, shellfish growing areas throughout Puget Sound, the Strait of Juan de Fuca and the ocean beaches are monitored for domoic acid. Unsafe levels have been found only in shellfish and crab from the outside coast. Low levels of domoic acid have been detected in the Strait of Juan de Fuca, Northern Puget Sound and Hood Canal.

►HAB History (Recent)

Significant Changes

1996 – Significant PSP levels detected in geoduck clams.

1. Port Gamble – Geoduck Clams in August reached 2,020 µg. The geoduck tract was closed from August 1996 to December 1996. This was a new high record for PSP toxin in shellfish for Port Gamble.
2. Kilisut Harbor – Blue Mussels in Mystery Bay in October reached 4,818 µg. Kilisut Harbor was closed from September 1996 to March 1997. This was a new high record for PSP toxin for Kilisut Harbor.
3. Recalls – 6 for the year.
4. Geoduck Tract Closures - 11

1997 – Unseasonably late fall PSP blooms occurred in South Puget Sound, Grays Harbor and Willapa Bay.

1. South Puget Sound - Blue Mussels in Case Inlet in December reached 6,799 µg. The bloom expanded to include Pickering, Pitt, and Peale Passages and Eld Inlet. These areas remained closed from November 1997 to January 1998. This bloom set ten new high records for South Puget Sound. Eight of the ten were over one thousand micrograms of PSP toxin. This bloom closed areas, which had no previous record of PSP toxin.
2. Grays Harbor - Pacific Oysters in Elk River reached 286 µg by November 20, 1997. The area was closed from November 1997 to December 1997. This bloom and closure set a record for it's late occurrence in the year.
3. Willapa Bay - Pacific Oysters in the Bruceport Area reached 341 µg on November 20, 1997. Likewise, harvest areas in Willapa Bay remained closed from November 1997 to December 1997. This bloom matched toxin level and time of occurrence with a bloom in Willapa Bay in 1957. All three of the blooms had a devastating financial impact on the commercial shellfish industry due to the time of the year the blooms occurred.
4. Recalls – 4, plus 2 where product was withheld from market.
5. Geoduck Tract Closures - 10

1998 – A fall PSP bloom in South Puget Sound resulted in five cases of illness. The illnesses occurred from the consumption of Blue Mussels from a commercial shellfish company in Carr Inlet. There were two major PSP blooms in Carr Inlet and Pitt Passage in 1998. This is the first time two major PSP blooms have occurred in any Washington shellfish area in one year.

1. First Bloom - In August, Blue Mussels from Penrose Pt. State Park reached 2,442 µg. Carr Inlet was closed from July 1998 to August 1998. Also in August, Geoduck Clams from Pitt Passage reached 1,015 µg. Pitt Passage was closed from July 1998 to September 1998.
2. Second Bloom - In October, Blue Mussels from Burley Lagoon reached 10,982 µg. Five people consumed commercial mussels and became ill with PSP symptoms. One man was hospitalized overnight. Carr Inlet was closed from October 1998 to December 1998. A product recall involved one company. Also, in October, Geoduck Clams from Pitt Passage reached 180 µg. The geoduck tract was closed from October 1998 to November 1998. Recalls involved five commercial companies, including one tribal enterprise. The second bloom expanded to include Case Inlet. It also represents the highest level on record since the 1978 bloom in Island County, which reached 30,000 µg.
3. Significant Domoic Acid Events - In September, domoic acid levels in Razor Clams began to rise on the

Puget Sound Research 2001

coastal beaches. By November, domoic acid in Razor Clams from Kalaloch had reached 295 ppm. This far exceeded the previous domoic acid record. The elevated level of toxin prevented the opening of the fall razor clam season. The level of toxin the following spring was still too high to allow a spring 1999 season as well.

4. Recalls – 8 for the year.
5. Geoduck Tract Closures - 32 - Highly variable toxin levels in individual clams.
 - A. Agate Pass - Closed 3 times in 1998.
 - B. Jamestown - Closed 5 times in 1998.
 - C. Mahnckes - Closed 3 times in 1998.
 - D. Murden Cove - Closed 5 times in 1998.
 - E. Skiff Point - Closed 5 times in 1998.

1999 – Massive PSP bloom occurred simultaneously statewide in July.

1. The PSP bloom pattern for Washington in 1999 was quite unique. Starting in June and gathering momentum in July, blooms of unusually large proportions hit Washington. Not only were the blooms massive, with the highest level in many areas over 1,000 µg, the blooms were also extensive, blanketing the state, from the Canadian border in the north, to Carr Inlet in South Sound and from Neah Bay, east to Anacortes. At the same time, minor blooms impacted Grays Harbor and Willapa Bay, where commercial shellfish toxin levels did not exceed the closure level.
2. Recalls – 10 for the year.
3. Geoduck Tract Closures - 26

2000 – Nine illnesses caused by extremely toxic PSP bloom in South Puget Sound.

1. The most active toxic area has been south of the Tacoma Narrows, where levels almost reached 3,000 micrograms in central Carr Inlet in early August. Two weeks later, Wollochet Bay, off Hale Passage, by Fox Island had toxin levels of 3,389 micrograms. A week after that, the department received reports of nine cases of PSP illnesses. Of the nine cases, seven saw a health provider, five were hospitalized and three of the five required artificial respirators. Mussels from Horsehead Bay in Carr Inlet, where most of illnesses originated were tested and found to contain 13,769 micrograms of PSP toxin. This was a very massive, strong, bloom that also closed four geoduck tracts in South Sound with toxin levels as high as 1,400 micrograms.
2. PSP blooms also affected Central Puget Sound, where East Kitsap County was heavily impacted. That bloom began in June, and by mid July most of the east side was closed, with highest levels of toxin in Dyes Inlet at 1,413 micrograms. King County followed behind Kitsap, with a slightly delayed bloom that closed the east shore of the county by the middle of August. The highest King County toxin level peaked at the end of July, at about half the Kitsap level, nearly reaching 700 micrograms. The bloom in Kitsap County closed five Geoduck tracts.
3. Recalls – 6 for the year.
4. Geoduck Tract Closures - 25

► Responses

Immediate

- Notification to Public—Recreational closures are listed on toll free Hotline 1-800-562-5632.
- Recalls From Marketplace—The Office of Food Safety & Shellfish Programs will initiate embargo or recall of commercial products if shellfish in wholesale shipment or retail markets are suspected of exceeding the biotoxin standards. A recall could involve authorities from local, state and federal agencies as well as authorities in foreign countries.
- Illness Surveillance—Investigation of illnesses that may have occurred as a result of biotoxins are conducted in cooperation with the DOH Office of Epidemiology and local health departments.
- WDF&W officers provide enforcement and investigation support and patrol affected areas.
- Area Closures—A single sample over 80 will close harvesting in a growing area for all growers.
- Increased Monitoring—Shift to weekly or batch testing.

- Notification to Industry—All results are reported to the industry and tribes by phone or fax as soon as the lab reports them.

Long Term

Outreach and education of public through LHD's, fairs, Oysterfest, newspaper articles, etc.

Changes in Biotxin Sampling

Collection	1970s	1990s
PSP	April to October	All Year
Domoic Acid	None	All Year
Testing	1970s	1990s
PSP	200-300 samples/yr	3000-3700 samples/yr
Domoic Acid	None	1000-1500 samples/yr